Ch:03

Emergence of IoT:

- IoT Growth- A statistical View,

- Application area of IoT,

- Characteristics of IoT,

- Things in IoT, IoT stack,

- Enabling Technologies, IoT challenges,

- IoT levels,

- Cyber physical systems versus IoT,

- Wireless sensor Network with IoT

- What is Internet?
  - The Internet is the global system of interconnected computer networks that use the Internet protocol suite (TCP/IP) to link devices worldwide.

  - It is a network of networks that consists of private, public, academic, business, and government networks of local to global scope, linked by a broad array of electronic, wireless, and optical networking technologies.

  - The Internet carries an extensive range of information resources and services, such as the inter-linked hypertext documents and applications of the World Wide Web (WWW), electronic mail, telephony, and peer-to-peer networks for file sharing.

IoT

- The Internet of Things (IoT) has been defined in a number of different ways in technical literature and popular media.

- Each definition reflects a different perspective and supports a different interest.

- While there is no universal definition of the IoT, these different definitions highlights IoT's common traits and can help illuminate its strengths and weaknesses while giving us a good sense of the tremendous impact IoT has on our life.

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IoT

- The Internet of Things is a system of interconnected computing devices, mechanical and digital machines, sensors, etc., who have the ability to share information with each other without any human intervention.

- It is a discreet network that gives all the devices and machines to think and adapt according to the surroundings.

- To do so it uses a set of data inputs and sensors to analyze and respond in a given situation.
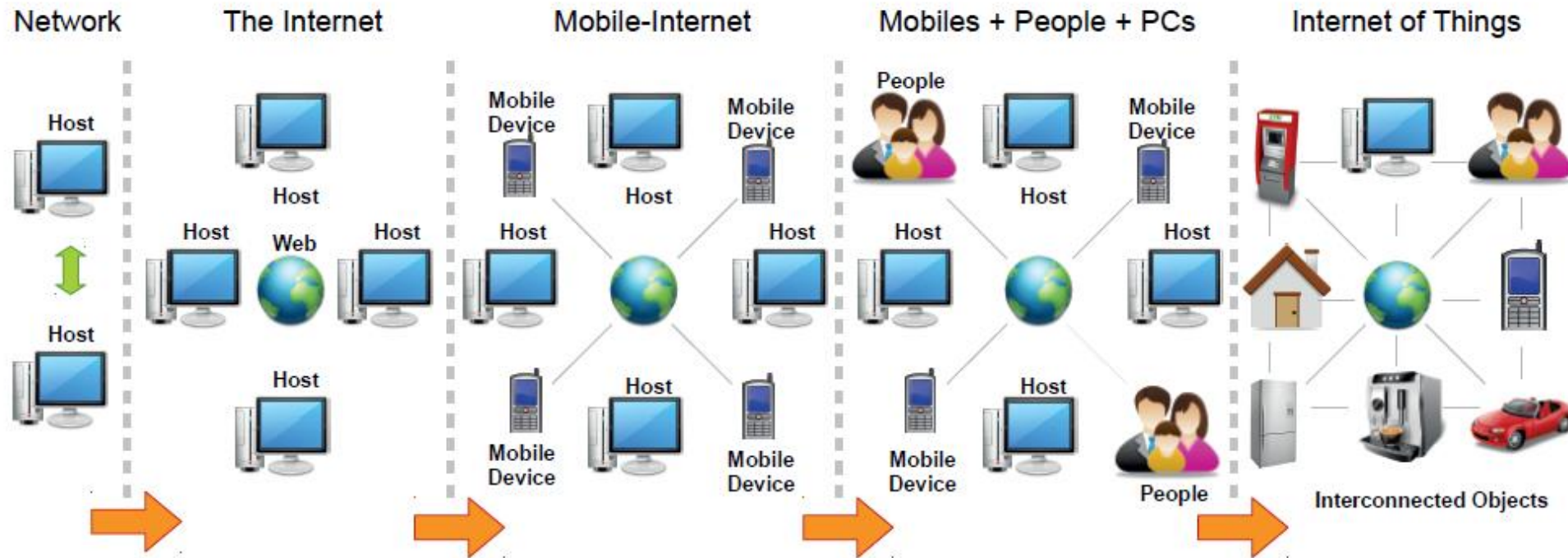
Evolution of Internet

Fig. 1. Evolution of the Internet in five phases. The evolution of Internet begins with connecting two computers together and then moved towards creating World Wide Web by connecting large number of computers together. The mobile-Internet emerged by connecting mobile devices to the Internet. Then, peoples' identities joined the Internet via social networks. Finally, it is moving towards Internet of Things by connecting every day objects to the Internet.

History of IoT
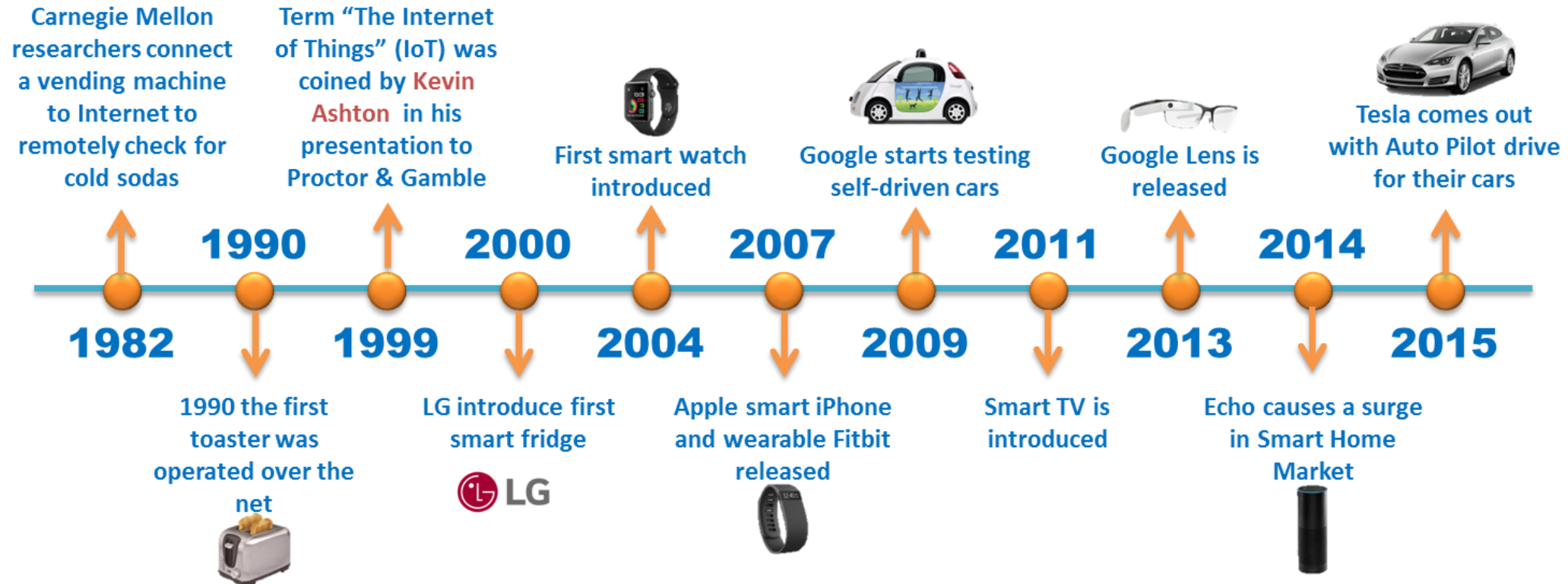
IoT Growth – A Statistical View

- From the "CISCO BSG 2011" presentation, one can see that IoT has a prodigious growth.

- CISCO BSG has predicted that by 2020, people would be using 50 billion smart objects.

- Also, a surprising fact is that each person would have six objects connected to the Internet.

- The projection for 2020 indicates a steep growth in the use of smart objects in comparison to 2023.
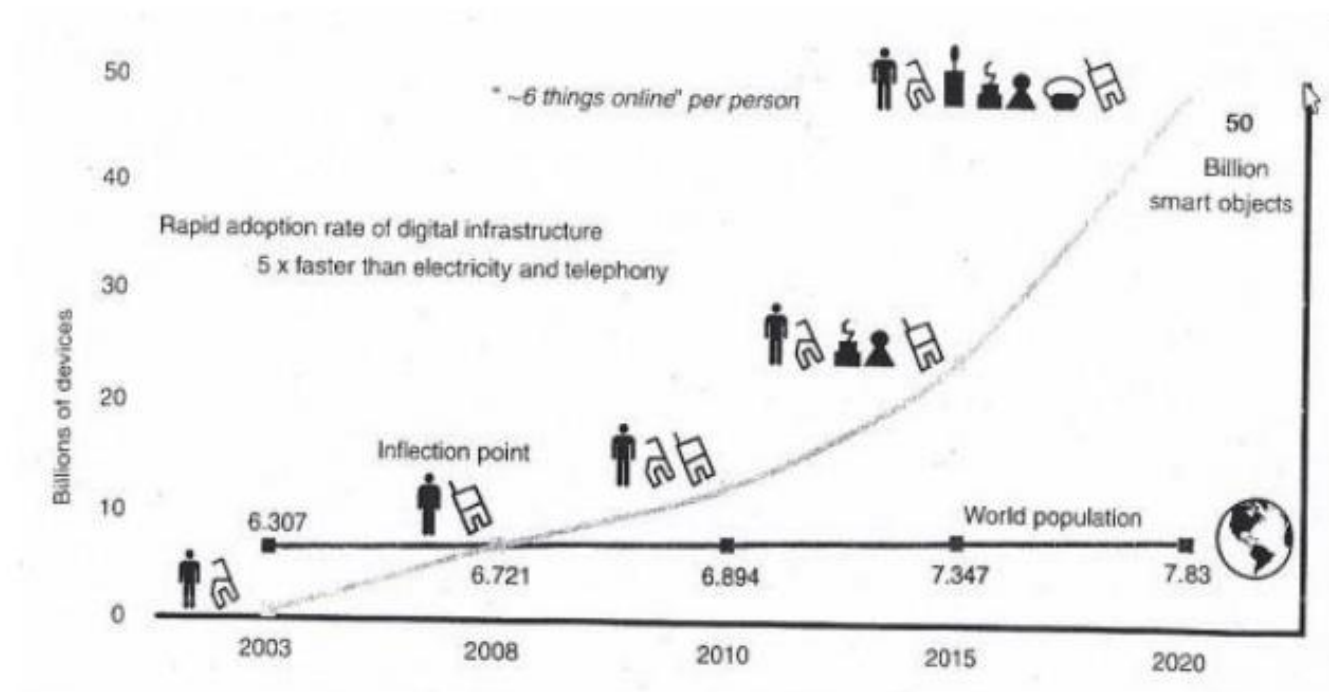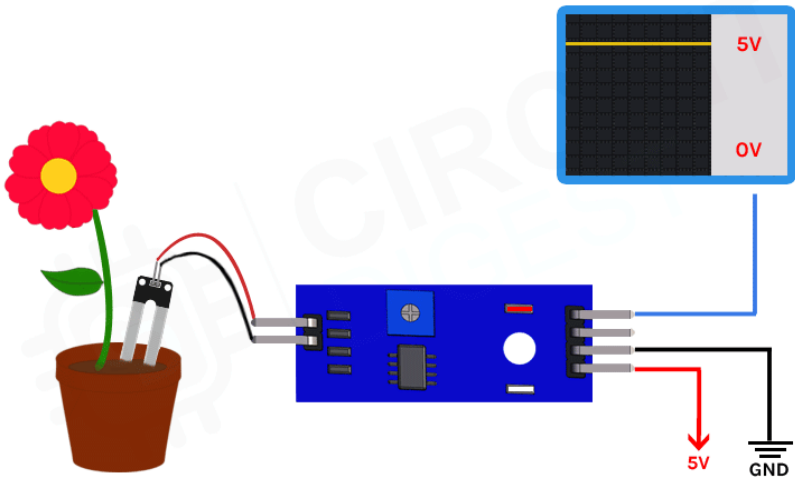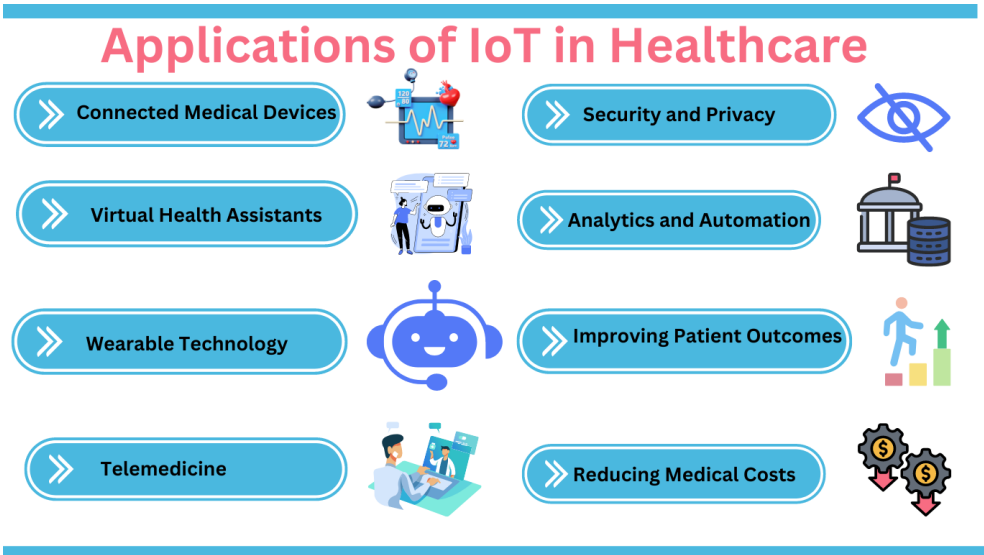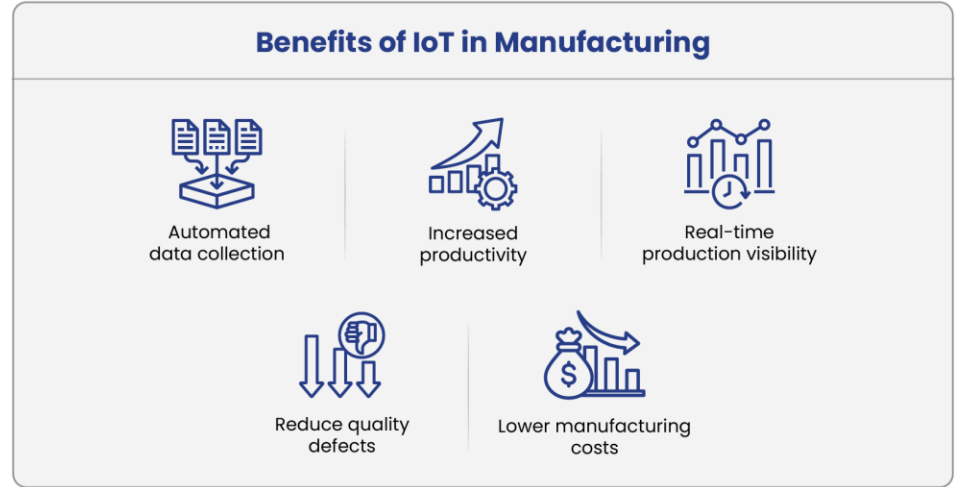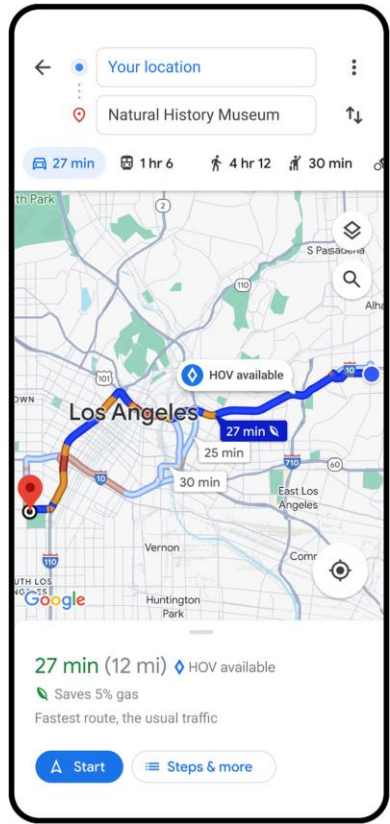
Figure 1.4 CISCO BSG – IoT growth prediction

- Not only CISCO, but many other major forums and organizations realized the potential of IoT development and have made or planned huge investments.
- Also, development of skill competence in IoT-related area is being undertaken by most organizations as they see huge business prospects in these areas.

Application Areas of IoT

- 1. IoT Applications in Agriculture

- Devices using IoT technology can sense soil moisture and nutrients, in conjunction with weather data, better control smart irrigation and fertilizer systems. If the sprinkler systems dispense water only when needed, for example, this prevents wasting a precious resource.

- 2. IoT Applications in Consumer Use

- For the private citizen, IoT devices in the form of wearables and smart homes make life easier. Wearables cover accessories such as Fitbit, smartphones, Apple watches, health monitors, to name a few. These devices improve entertainment, network connectivity, health, and fitness.

- Smart homes take care of things like activating environmental controls so that your house is at peak comfort when you come home.

- 3. IoT Applications in Healthcare

- First and foremost, wearable IoT devices let hospitals monitor their patients' health at home, thereby reducing hospital stays while still providing up to the minute real-time information that could save lives.

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- 4. IoT Applications in Insurance

- Even the insurance industry can benefit from the IoT revolution. Insurance companies can offer their policyholders discounts for IoT wearables such as Fitbit. By employing fitness tracking, the insurer can offer customized policies and encourage healthier habits, which in the long run, benefits everyone, insurer, and customer alike.

- 5. IoT Applications in Manufacturing

- RFID and GPS technology can help a manufacturer track a product from its start on the factory floor to its placement in the destination store, the whole supply chain from start to finish. These sensors can gather information on travel time, product condition, and environmental conditions that the product was subjected to.

- 6. IoT Applications in Traffic Monitoring

- A major contributor to the concept of smart cities, the Internet of Things is beneficial in vehicular traffic management in large cities. Using mobile phones as sensors to collect and share data from our vehicles via applications like Google Maps or Waze is an example of using IoT. It informs about the traffic conditions of the different routes, estimated arrival time, and the distance from the destination while contributing to traffic monitoring.

Los Angeles

HOV available

27 min
25 min
30 min

27 min (12 mi)   HOV available
Saves 5% gas
Fastest route, the usual traffic

Start   Steps & more

Benefits of IoT in Manufacturing

Automated data collection

Increased productivity

Real-time production visibility

Reduce quality defects

Lower manufacturing costs

Applications of IoT in Healthcare

Connected Medical Devices

Security and Privacy

Virtual Health Assistants

Analytics and Automation

Wearable Technology

Improving Patient Outcomes

Telemedicine

Reducing Medical Costs

5V

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5V   GND

- IoT Applications in Smart Home

- IoT allows you to connect all your home applications like air conditioners, lighting, locks, thermostat, theft alarm systems, and whatnot into a single system and have the control at your fingertips with a smartphone.

- IoT Applications in Smart Cities

- A combination of sensors in different capacities throughout the city for various tasks such as managing the traffic, handling waste management, optimizing streetlights, saving water, monitoring energy expenditure, creating smart buildings, and more.

- Indore, Ahmedabad, Coimbatore are awarded as smart cities.

Modern Applications:

1. Smart Grids and energy saving

2. Smart cities

3. Smart homes/Home automation

4. Healthcare

5. Earthquake detection

6. Radiation detection/hazardous gas detection

7. Smartphone detection

8. Water flow monitoring

9. Traffic monitoring

10. Wearables

11. Smart door lock protection system

12. Robots and Drones

13. Healthcare and Hospitals, Telemedicine applications

14. Security

15. Biochip Transponders(For animals in farms)

16. Heart monitoring implants(Example Pacemaker, ECG real time tracking)

Advantages of IoT :

1.Improved efficiency and automation of tasks.

2.Increased convenience and accessibility of information.

3.Better monitoring and control of devices and systems.

4.Greater ability to gather and analyze data.

5.Improved decision-making.

6.Cost savings.

Disadvantages of IoT :

1.Security concerns and potential for hacking or data breaches.

2.Privacy issues related to the collection and use of personal data.

3.Dependence on technology and potential for system failures.

4.Limited standardization and interoperability among devices.

5.Complexity and increased maintenance requirements.

6.High initial investment costs.

7.Limited battery life on some devices

8. Concerns about job displacement due to automation.

- Internet of Things (IoT) is a system of interconnected objects, usually called smart devices, through the Internet.

- The object can be a heart monitor, a remote, or an automobile with built-in sensors.

- That is objects that have been assigned an IP address and have the capability to collect and transfer data over a network.

- The objects interact with the external environment with the help of embedded technology, which helps them in taking decisions. Since these devices can now represent themselves digitally.

- **Internet**: Inter connectivity-For global connection

- **+**

- **Things**: Embedded system devices-sensors, actuators, RFID tags, QR codes and so many.

- For sensing the data

- Collecting the data

- Sending the data

- Thus, on the whole, the Internet of Things is the technology that enables everything to communicate by themselves over the internet through devices without the use of computers.

- Here comes the most essential and prevalent term in IoT called 'Smart' which means Automation – the process of decreasing human intervention or involvement thereby increasing the machine intelligence to perform every task by itself, which could be done by IoT

CHARACTERISTICS OF IOT

- Connectivity   –
  Connectivity is an important requirement of the IoT infrastructure. Things of IoT should be connected to the IoT infrastructure. Anyone, anywhere, anytime can connect, this should be guaranteed at all times.
  - For example, connection between people through internet devices like mobile phones ,and other gadgets, also connection between Internet devices such as routers, gateways, sensors, etc.

- Intelligence   and   Identity   –
  The extraction of knowledge from the generated data is very important.
  - For example, a sensor generates data, but that data will only be useful if it is interpreted properly. Each IoT device has a unique identity. This identification is helpful in tracking the equipment and at times for querying its status.

- Scalability –
  The number of elements connected to the IoT zone is increasing day by day. Hence, an IoT setup should be capable of handling the massive expansion. The data generated as an outcome is enormous, and it should be handled appropriately.

- Dynamic and Self-Adapting (Complexity) – IoT devices should dynamically adapt themselves to the changing contexts and scenarios.
  - Assume a camera meant for the surveillance. It should be adaptable to work in different conditions and different light situations (morning, afternoon, night).

- Architecture – IoT architecture cannot be homogeneous in nature. It should be hybrid, supporting different manufacturers ' products to function in the IoT network. IoT is not owned by anyone engineering branch. IoT is a reality when multiple domains come together.

- Safety – There is a danger of the sensitive personal details of the users getting compromised when all his/her devices are connected to the internet. This can cause a loss to the user data. Hence, data security is the major challenge. Besides, the equipment involved is huge. IoT networks may also be at the risk. Therefore, equipment safety is also critical.

- Self-Configuring – This is one of the most important characteristics of IoT. IoT devices are able to upgrade their software in accordance with requirements with a minimum of user participation. Additionally, they can set up the network, allowing for the addition of new devices to an already-existing network.

THINGS IN INTERNET OF THINGS

- In the context of IoT, things refer to a variety of devices At times, even humans in the loop become a thing.

- For something to qualify as a "thing" it requires identity of its existence.

- The "thing" in a network can monitor/measure; for example, a temperature sensor could be a thing.

- Things are capable of exchanging data with other connected devices in the system.

- The data could be stored in a centralized server (or cloud), processed there and a control action could be initiated.

- The devices involved in getting this accomplished are known as things

- Some of the famous "things" that you would already be aware of are temperature sensors, pressure sensors, humidity sensors, etc.

- The data from these sensors is collected (real time) and sent to the cloud (rather than a local server).

- Based on the data analysis, the control action would be taken.

- For example, switching off the water heater remotely when the water is heated as per requirement.

- Not just sensors, the following can also be called as things:

Figure 1.6 "Things" in internet of things

1. Industrial motors.

2. Wearables (e.g., watch).

3. Vehicles.

4. Shoes.

5. Heart monitoring implants (eg, pacemaker, ECG real-time tracking).

6. Biochip transponders (for animals in farms).

7. Automobiles with built-in sensors (automobile feature real-time monitoring).

 8. Food/perishables quality measuring.

Remember: "THINGS" = HARDWARE + SOFTWARE + SERVICE

IoT-based home automation

1. Lighting control and automation devices.

2. Ventilation devices.

3. Air conditioning [heating, ventilation and air conditioning (HVAC)] systems.

 4. Appliances such as washer/dryer.

5. Air purifiers.

6. Ovens or refrigerators/freezers that use Wi-Fi for remotemonitoring.

7. Security cameras.

8. Smart phones.

- List the things that could be in smart retail environment

Thank you